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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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APPLIED MATERIALS, INC.
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EXAMINER

ZERVIGON, RUDY

ART UNIT	PAPER NUMBER
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1763

DATE MAILED: 09/13/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/298,064

Applicant(s)

XING ET AL.

Examiner

Rudy Zervigon

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 June 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

1. The June 16, 2005 decision by the Board of Patent Appeals and Interferences has affirmed the Examiner's finally rejected claims of 1-7, 17, and 18. The same decision has reversed the Examiner's finally rejected claim 20. Applicant's time period for requesting a rehearing under 37 CFR 1.197(b) expired on August 16, 2005. As a result, the status of claims 1-7, 17, and 18 are considered concluded (MPEP 1214.06). A new action on the merits for claim 20 is issued below.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mehrdad M. Moslehi (USPat. 5,082,517) in view of P. J. Matsuo et al¹. Moslehi teaches the control of the composition of neutral and reactive species, and it's importance to plasma processing, is taught by Mehrdad M. Moslehi (column 1, lines 46-68; column 2, lines 37-42; column 4, lines 9-14; column 12, lines 56-68). Specifically, Mehrdad M. Moslehi describes a process conversion (column 4, lines 55-60) system including:

¹J.Vac.Sci.Technol. A 15(4), Jul/Aug 1997

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- i. A system (Figure 1) for reacting a plasma with a substrate
- ii. a first chamber (18, Figure 1)
- iii. a gas source (12, Figure 1) coupled to the first chamber comprising
- iv. constituents (12, Figure 1) adapted to react with a substrate (48, Figure 1)
- v. an energy source (38) coupled to the first chamber
- vi. a second chamber (24) configured to house a substrate for processing
- vii. a machine readable storage medium (40) configured to control the introduction of a gas from the gas source into the first chamber (column 12, lines 65 – column 13, line 14; column 13, lines 57-68, 33-43) and to control the introduction of an energy from the energy source (column 5, lines 43-52)
- viii. executable program instructions for the machine readable storage medium comprising a computer readable medium having a computer-readable program embodied therein for directing operation of the system (column 5, lines 43-52; column 14, lines 3-20), the computer readable program comprising:
 - ix. instructions for controlling the gas source (column 14, 3-20) and the energy source (column 14, lines 3-20) to convert a portion of a gas supplied by the gas source into a plasma comprising plasma nitrogen ions and radicals (column 4, lines 9-14; column 10, lines 55-60, definition of plasma) and to deliver the plasma to the second chamber substantially (column 4, lines 9-14; column 11, lines 54-63; column 1, lines 46-52) free of nitrogen ions to react with a substrate in the second chamber in a process conversion step

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Moslehi does not teach transferring the plasma radicals via a distance equivalent to the lifetime of the nitrogen ions into a second chamber substantially free of ions.

Matsuo et al teaches a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate location (Section I, Introduction; Figure 1). Additionally, the variable length of the plasma delivery tube is assessed under numerous conditions such as etch rates (Section III.A.2, p.1803), reaction layer thickness (Section III.C.4, p.1809), atomic (neutral) and reactive (radical) species concentration (Section IV.B, p.1812).

Specifically, and to further illustrate the teachings of P. J. Matsuo et al, the researchers describe:

- i. a first reaction chamber (Adownstream tubing/lining, “Applicator” box portion of Adownstream tubing/lining, Figure 1)
- ii. a gas source (fluoromethane, oxygen, nitrogen, Figure 1) coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber
- iii. an excitation energy source (Aapplicator, 2.45GHz, Figure 1) coupled to the first reaction chamber to generate a nitrogen plasma comprising nitrogen ions and radicals from the nitrogen gas
- iv. a second reaction chamber (Aprocessing chamber, Fig.1) adapted to house a substrate at a site in the second reaction chamber
- v. wherein the first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the nitrogen ions (Figure 4) at a plasma generation rate such that the radicals react with the substrate in a process

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conversion step (film deposition, Refer to Figure 10(d) and section C.1 - At point (d) N₂ is injected once more and the reaction layer thickness increases again.)

- vi. the excitation energy source supplies energy having a microwave frequency to generate a plasma from the nitrogen gas (abstract, first sentence)
- vii. The dimensions of the first reaction chamber (A...as the distance from the plasma to the etching region is increased...) are configured such that substantially all of the nitrogen ions generated by the nitrogen plasma are changed from an ionic state to a charge neutral state within the first reaction chamber (Section IV.B, p.1812; Figure 25)
- viii. An apparatus (Figure 1) for exposing a substrate to plasma, comprising a first reaction chamber (A downstream tubing/lining, Figure 1)
- ix. means for supplying a nitrogen gas (fluoromethane, oxygen, nitrogen, Figure 1) to the first reaction chamber
- x. means for generating a plasma from the nitrogen gas (applicator, 2.45GHz, Figure 1)
- xi. the plasma comprising nitrogen ions and radicals (definition of plasma)
- xii. a second reaction chamber (processing chamber, Fig.1) having means for housing a substrate

- xiii. means for providing the plasma to the second reaction chamber substantially free of nitrogen ions such that the radicals react with a substrate in a process conversion step (Section IV.B, p.1812)

Item v above appears to be implicitly taught according to Figure 4. As shown in Figure 4, there are non-zero etch rates up to 125cm of first reaction chamber lengths. As such, lifetime of the nitrogen ions, up to and including these distances, are sufficiently long enough so that the radicals react with the substrate in a process conversion step. However, although P. J. Matsuo et al teach all the structural limitations as described above, Matsuo's operation of the provided structure (Figure 1), as described in the reference, is not completely clear in anticipation that Matsuo's operation can provide a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate.

However, Matsuo states that the separation distance plays a major role in which reactive species survive and reach the processing chamber (Section III.B.2, Page 1803, second sentence) under the variable conditions of flow control ("Mass Flow Controllers"; Figure 1) and microwave power (Section II - Experimental).

Matsuo's processing parameters of tube length, flow control, and microwave power can be optimized to meet the claimed property and function such that transferring of the plasma radicals via a distance equivalent to the lifetime of the nitrogen ions into a second chamber substantially free of ions.

It would have been obvious to one of ordinary skill in the art at the time the invention was made for Moslehi to optimize the operation (variable length, flow rate, microwave power, gas identity,

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pressure; Section II – Experimental Apparatus and Procedure) of the apparatus, as taught by Matsuo, to provide a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate as taught by Matsuo.

Motivation for Moslehi to optimize the operation of the apparatus to provide a separation between chambers such that the separation is equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate is to form a desired film with desired characteristics as taught by Matsuo (Section IV.B, p.1812). Further, it would be obvious to those of ordinary skill in the art to optimize the operation of the claimed invention (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); In re Hoeschele , 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989); In re Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

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Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (571) 272.1442. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official fax phone number for the 1763 art unit is (703) 872-9306. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (571) 272-1700. If the examiner can not be reached please contact the examiner's supervisor, Parviz Hassanzadeh, at (571) 272-1435.



9/12/5